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\documentclass[11pt]{article}

% ---------- Packages ----------
\usepackage[a4paper,margin=1in]{geometry}
\usepackage{amsmath,amssymb,amsfonts}
\usepackage{physics}
\usepackage{bm}
\usepackage{hyperref}
\usepackage{cite}
\usepackage{authblk}

% ---------- Metadata ----------
\title{\textbf{The Structural Plenitude Theory (SPT):}\\
A Viscoelastic Substrate for Light, Gravitation, and Cosmological Redshift}

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% --- Date and Version ---
\date{2025 \\ \vspace{0.2cm} \small Version 1.1}

% ---------- Document ----------
\begin{document}
\maketitle

% ---------- Abstract ----------
\begin{abstract}
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We propose the \emph{Structural Plenitude Theory (SPT)}, a physical framework in which electromagnetic propagation, apparent gravitation, and cosmological redshift emerge from interactions with a continuous, viscoelastic substrate termed the \emph{Pleroma}. In this approach, electromagnetic constants are derived via energetic equivalence with mechanical properties of the medium, the speed of light arises as the shear-wave velocity of the substrate, gravitation is reinterpreted as structural confinement rather than a fundamental force, and cosmological redshift results from causal dissipation with non-local memory, without invoking metric expansion. The theory introduces the concept of \emph{Occupational Exchange} to replace the vacuum--inertia duality, providing a unified causal substrate with falsifiable experimental predictions.

\end{abstract}

\noindent\textbf{Keywords:} Foundations of physics; Structural Plenitude; Pleroma; Occupational Exchange; Emergent gravity; Cosmological redshift; Viscoelastic media.

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\section{Ontological Motivation: The Fallacy of the Vacuum}

Modern physics treats fields and spacetime geometry as primitive entities. The Structural Plenitude Theory addresses this ontological gap by postulating a real, continuous physical substrate—the \emph{Pleroma}. Within this framework, the concept of an absolute vacuum is understood as a linguistic abstraction corresponding to the equilibrium state of the substrate. There is no ``empty'' space; every volume is structurally occupied, and all motion is a process of continuous \textbf{Occupational Exchange} within the medium.

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\section{The Pleroma: Definition and Properties}

The Pleroma is defined as a continuous, physically real medium characterized by an effective density ρ_ϕ, shear modulus G_ϕ, viscosity, and non-local (causal) memory. It constitutes the structural matrix that mediates propagation, resistance, and organization across physical systems, serving as the underlying substrate for observable interactions.

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\section{Energetic Derivation of $\varepsilon_0(\phi)$ and $\mu_0(\phi)$}

Equating electromagnetic energy density with the mechanical energy density of transverse modes yields:

\begin{equation}

\varepsilon_0(\phi) = \frac{\rho_0}{\alpha_c^2}, \qquad

\mu_0(\phi) = \frac{\gamma_c^2}{G_\phi}.

\end{equation}

From these expressions follows the fundamental relation:

\begin{equation}

\boxed{\mu_0 \varepsilon_0 = \frac{\rho_0}{G_\phi}}

\quad \Rightarrow \quad

\boxed{c = \sqrt{\frac{G_\phi}{\rho_0}}}.

\end{equation}

Accordingly, the speed of light is identified as the shear-wave velocity of the Pleroma.

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\section{Inertia as a Hierarchy of Accommodation}

Within the SPT framework, inertia is not treated as an intrinsic property of mass but as the resistance of the Pleroma to structural rearrangement. We introduce a \emph{Hierarchy of Accommodation}, wherein different material structures exhibit varying degrees of coupling and exchange rates with the substrate. This perspective accounts for the persistent dynamical activity of microscopic systems (e.g., Zitterbewegung) while explaining why macroscopic bodies require substantial flux gradients to alter their state of motion.

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\section{Causal Redshift and Emergent Gravitation}

\subsection{Causal Redshift}

By introducing a frequency-renormalized dissipation kernel,

\begin{equation}

\eta_\phi(\omega) \propto \frac{1}{\omega},

\end{equation}

the framework yields a redshift relation

\begin{equation}

\frac{\Delta \nu}{\nu} \approx \frac{H_0}{c}\, d,

\end{equation}

without invoking metric expansion of spacetime.

\subsection{Gravitation as Structural Confinement}

Gravitation emerges as an effect of structural confinement within the Pleroma. Spatial variations in substrate properties define an effective refractive index

\begin{equation}

n_\phi(x) = \sqrt{\frac{\rho_\phi(x)}{G_\phi(x)}},

\end{equation}

which reproduces gravitational lensing phenomena through refraction, without treating spacetime curvature as a primitive entity.

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\section{Experimental Falsifiability: The Rotating Blade Test}

The SPT predicts that a rotating dielectric system induces a measurable spectral shift due to substrate drag:

\begin{equation}

\frac{\Delta \nu}{\nu} \sim \kappa \frac{\Omega R}{c}.

\end{equation}

The absence of such a signal under electromagnetic shielding conditions would falsify the proposed framework.

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\section{Conclusion}

The Structural Plenitude Theory offers a unified viscoelastic substrate for light propagation, gravitation, and cosmological redshift. By replacing primitive postulates with mechanical causation and the principle of Occupational Exchange, the theory provides a coherent ontological foundation while preserving established phenomenology and enabling experimental scrutiny.

\end{document}